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Seismic image of incoming plate to the Japan Trench

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Recent geophysical and geochemical studies well demonstrate that the subducting oceanic lithosphere and volatile migration from it are primary factors to control active processes in subduction zones, such as seismic and volcanic activity. But, little is known about structures of oceanic lithosphere and their variation towards trenches. From 2009, IFREE, JAMSTEC has started active source seismic imaging project of the incoming plate to the Kuril, Japan and Izu-Bonin trenches. Our first seismic data, in this project, acquired along a 500-km long north-south aligned profile off the Kuril trench shows striking new views of the oceanic crust and uppermost mantle; i.e., very high velocity in the uppermost mantle immediately below Moho (Vp = 8.5 km/s), lower crustal reflectors dipping to the paleo-ridge with uniform spacing and dip angle and velocity reduction of the crust and the mantle toward the trench from the outer rise region (Fujie et al., 2010). Here, we present results of our second dip-profile perpendicular to the Japan trench in order to compare the seismic image of the off-Kuril profile. Data acquisition parameters are the same in the two profiles. We deployed 75 OBSs with 6-km interval and a 7800-cu. -inches tuned air-gun array of R/V Kairei was shot at every 200 m for acquiring refraction data. Multichannel reflection data are also obtained along the profile using a 444-channle hydrophone streamer cable (6 km long). Data qualities of the OBS-refraction data and the multichannel reflection are generally excellent along the entire profile. The seismic reflection image clearly shows continuous Moho reflection except for the region beneath the horst-graben as well as small seamounts. A notable difference of the reflection image between the off-Kuril-trench profile and the off-Japan-trench profile is reflection character in the lower crust. The lower crustal reflectors in the off-Japan-trench profile generally show lower dip angle. This may indicate the off-Kuril-trench profile is aligned more close to the maximum dip direction of the lower crustal reflectors. Another important difference between the two profiles is observed in the uppermost mantle; i.e., the uppermost mantle velocity along the Japan-trench-profile is around 8.0 km/s which is significantly lower than that along the off-Kuril-profile. This is interpreted to be caused by the seismic anisotropy due to the paleo-mantle flow which provides the fast P-wave direction along the off-Kuril trench. Although we may need further data processing, the current velocity model seems to show the velocity reduction of the uppermost mantle towards the Japan trench.

Keywords: oceanic lithosphere, seismic image, outer rise, seismic anisotropy